fact sheet

Savannah River Site

Tritium & SRS Offsite Releases - An Update

The majority of the radioactivity released into the environment from SRS operations has been tritium. Tritium is a radioactive isotope of hydrogen with a half-life of 12.4 years; it is used to boost the firepower of nuclear weapons. It has been produced at SRS since October 1955.

Tritium emits a very low energy beta particle; its chemical form determines how it will interact with living systems. Tritium as water (tritiated water) moves exactly as does water in the body. Thus it does not remain in the human body for long, unlike many other radionuclides including plutonium.

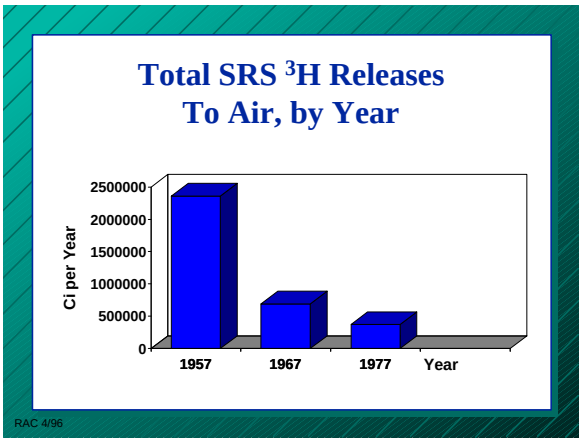
Tritium's toxicity varies depending on whether it is present as a gas, as water or water vapor, or as part of a more complex molecule. The toxicity of tritiated water is many times greater than for exposure to tritium gas. Estimating dose and risk from SRS operations is difficult because tritium was released in both forms and the records may not be clear as to which form was actually released in a specific event. Further confounding risk assessment is the fact that tritium gas is gradually converted to tritiated water as it moves through the environment.

Tritium Production and Release at SRS

Tritium operations began at the SRS in several main areas:

- the Reactors area, where five production reactors located on a circle well within the site were used to irradiate lithium targets to produce tritium and other materials;
- the Chemical Separations areas (F and H areas), where materials from the reactors were separated to recover the desired products;
- the Tritium Packaging area, where the gas was greatly compressed and transferred to containers to be shipped elsewhere.

Both the reactor and packaging areas experienced significant airborne releases over the years. In particular, the high-pressure operations in the packaging area lead to numerous accidental airborne releases via equipment failures or operator errors. Chemical separations plant releases were generally to surface and groundwater. While some tritium released to groundwater soon evaporated to the atmosphere, much remained in the ground, with some moving slowly toward release to site streams. Tritium and some other radionuclides are still being released from SRS in this manner today.



Radiological Assessments Corporation (*RAC*), under contract to the Centers for Disease Control and Prevention, is examining SRS releases to air and surface water. *RAC* scientists have focused their initial efforts on the years 1962-64, when site operations and production levels were high, technology to control releases was still in its infancy, and releases were therefore likely to have been high. Records for this period are reasonably complete; researchers have located SRS monthly, semi-annual, and annual reports. These are being carefully compared to the more detailed, often handwritten, original records that have also been discovered.

Tritium Releases Seen Via Monitoring Records

Hundreds of site documents have been reviewed in order to identify the important routine and accidental tritium releases. *RAC* is in the process of researching the types of monitoring techniques that were used during the 1950s and 60s, and is analyzing a large set of original monitoring records.

During the 1950s and 60s there were two types of airborne tritium monitoring systems employed at SRS. Initially during that period, a dehumidifier method was used to monitor releases from stacks of the reactor buildings, where the predominant releases were from the evaporation of leaked tritiated water. This method provided a measurement of total activity, but did not provide information on the rate or time of release. In the early 1960s a more advanced stack monitor was developed, providing more detailed release data.

The site began reporting tritium release estimates for the F & H (separations) facilities and for the five operating reactors in mid-1955. *RAC* researchers located tritium release data, reported two times a year, for each of the five reactors for this period. More detailed data exist for later years. In addition, monthly data were published for the separations facilities. Researchers have found two sets of handwritten logbooks reporting daily and monthly tritium releases for some of the key areas in the separations facilities. These are being used to verify published values. To date, the "summary" values compare well with values from the more detailed logbook data. During 1962-1964, approximately 68% of the total atmospheric tritium released from SRS originated in the separations areas and about 31% was released from the five reactors.

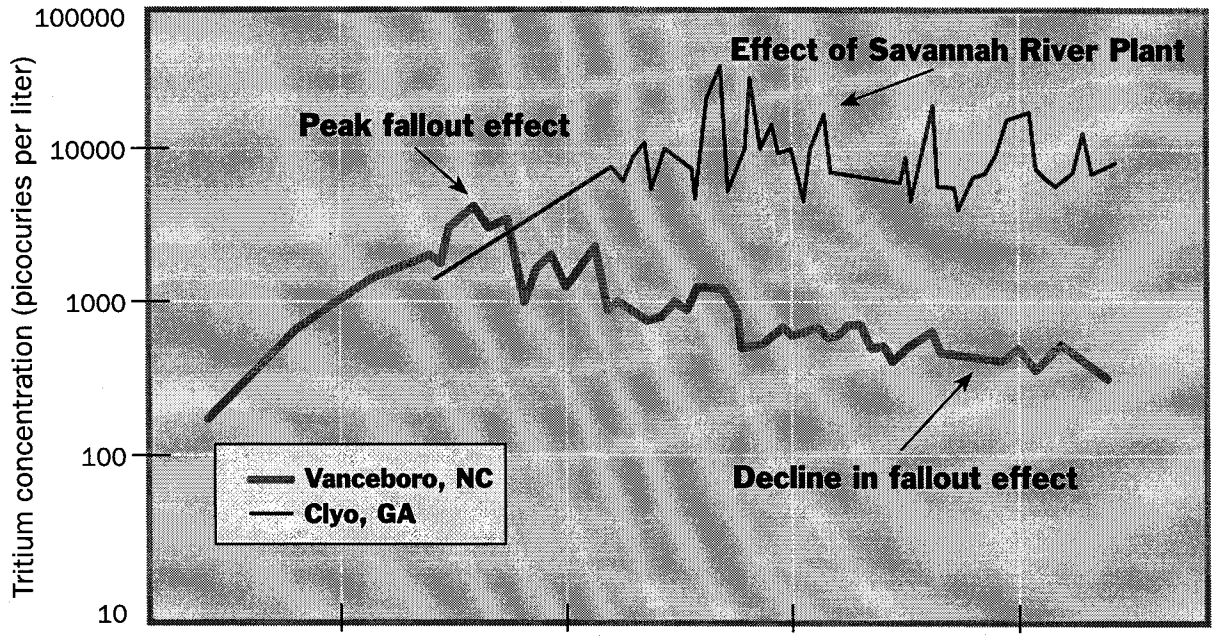
Monitoring Tritium Releases To Water

The SRS location was originally chosen because of its proximity to the Savannah River, a source of water used to remove reactor heat, and in chemical processing. At least five major streams on the SRS received liquid wastes from the processes onsite. The five streams, Upper Three Runs Creek, Four Mile Creek, Pen Branch, Steel Creek and Lower Three Runs Creek, all flow to the Savannah River.

As with tritium releases to air, most of the tritium released in liquid effluents at the SRS came from either the reactors or the separations facilities. Water from the Savannah River, pumped to large reservoirs in each area, cooled the reactors via heat exchangers. Some tritium leaked from the reactors to the heat exchangers, and from spent fuel and targets to the disassembly basin, a large water-filled storage tank. This water then moved to site streams.

Releases to site streams and groundwater from the Separations Area came primarily from the seepage basins, from the cooling water systems, and from spills to the storm sewer systems in the area. Unlined seepage basins were constructed in each of the two chemical separations areas prior to startup in 1955, and were designed to receive waste water and low level radioactivity from the separations areas. They were intended to allow most of the radioactivity to decay before reaching Four Mile Creek, the closest onsite stream.

While the SRS was certainly responsible for the release of tritium to the Savannah River, nuclear weapons tests, occurring elsewhere in the world, were also releasing very large quantities of tritium during the early 1960s. The figure below illustrates the need for care in identifying the sources of tritium concentrations in the



Savannah River. Measurements taken in mid-1963 from rivers in North Carolina and Florida (rivers not significantly influenced by SRS releases) show large tritium increases from weapons fallout. Measurements in the Savannah River after 1963 show the clear influence of site releases of tritium.

Weekly monitoring of tritium releases to the seepage basins and from the cooling water systems was begun in the late 1950s. *RAC* researchers are inspecting Environmental Monitoring Monthly Reports and Radiological Control and Methods Reports, which are valuable in understanding tritium release patterns. From 1962 to 1964, these reports were 25 to 30 pages in length, and provided quite thorough summaries of effluent and environmental monitoring for both airborne and waterborne releases.

To check the accuracy of these summary reports, researchers have been able to obtain copies of the original data sheets from early operations. These handwritten entries provide more detailed measurements for the radionuclides summarized in the monthly reports. The data sheets include occasional stream or river flow data, and some quality control information needed to allow *RAC* to establish the level of confidence concerning estimates being made.

Evaluation of SRS tritium releases will continue throughout the dose reconstruction project; results are expected to make up a significant fraction of overall estimated offsite impact.